

- 1        1. A composition providing sustained release of a drug, the composition comprising  
2        a mucopolysaccharide, a carrier protein, and a drug.
  
- 1        2. The composition of claim 1, wherein the composition consists of the  
2        mucopolysaccharide, the carrier protein, the drug, and one or more pharmaceutically  
3        acceptable additives.
  
- 1        3. The composition of claim 1, wherein the ratio of the total mass of  
2        mucopolysaccharide in the composition to the total mass of carrier protein in the composition  
3        is about 1:1 to 1:20.
  
- 1        4. The composition of claim 1, wherein the mucopolysaccharide is chondroitin  
2        sulfate or hyaluronate.
  
- 1        5. The composition of claim 1, wherein the carrier protein is a  $\gamma$ -globulin, albumin,  
2        fibrinogen, histone, protamine, gelatin, or collagen.
  
- 1        6. The composition of claim 1, wherein the carrier protein is a  $\gamma$ -globulin.
  
- 1        7. The composition of claim 1, wherein the carrier protein is an albumin.
  
- 1        8. The composition of claim 1, wherein the drug is a protein drug.
  
- 1        9. The composition of claim 8, wherein the protein drug is an erythropoietin,  
2        granulocyte colony stimulating factor, granulocyte macrophage colony stimulating factor,  
3        thrombopoietin, interferon- $\alpha$ , interferon- $\beta$ , interferon- $\gamma$ , urokinase, tissue plasminogen  
4        activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,  
5        brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide  
6        dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1       10. The composition of claim 1, wherein the composition contains about 0.1 to 50%  
2       by weight the mucopolysaccharide.

1       11. The composition of claim 1, wherein the composition contains about 0.1 to 2%  
2       by weight the drug.

*Subj*  
~~12. A method of producing a sustained release drug composition, the method  
2       comprising  
3       providing a precipitating solution containing a mucopolysaccharide, a carrier protein,  
4       and a drug;  
5       lowering the pH of the precipitating solution to a level sufficient to form an insoluble  
6       product comprising the mucopolysaccharide, the carrier protein, and the drug; and  
7       collecting from the precipitating solution the insoluble product.~~

1       13. The method of claim 12, wherein the insoluble product consists of the  
2       mucopolysaccharide, the carrier protein, the drug, and one or more pharmaceutically  
3       acceptable additives.

1       14. The method of claim 12, wherein the ratio of the total mass of  
2       mucopolysaccharide in the insoluble product to the total mass of carrier protein in the  
3       insoluble product is about 1:1 to 1:20.

1       15. The method of claim 12, wherein the mucopolysaccharide is chondroitin sulfate  
2       or hyaluronate.

1       16. The method of claim 12, wherein the carrier protein is a  $\gamma$ -globulin, albumin,  
2       fibrinogen, histone, protamine, gelatin, or collagen.

1       17. The method of claim 12, wherein the carrier protein is a  $\gamma$ -globulin.

1       18. The method of claim 12, wherein the carrier protein is an albumin.

1       19. The method of claim 12, wherein the drug is a protein drug.

1       20. The method of claim 12, wherein the protein drug is an erythropoietin,  
2       granulocyte colony stimulating factor, granulocyte-macrophage colony stimulating factor,  
3       thrombopoietin, interferon- $\alpha$ , interferon- $\beta$ , interferon- $\gamma$ , urokinase, tissue plasminogen  
4       activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,  
5       brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide  
6       dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1       21. The method of claim 12, wherein the pH of the solution is about 7 or above  
2       before the lowering step.

1       22. The method of claim 12, wherein the pH of the solution is lowered to about 2 to 4  
2       in the lowering step.

1       23. The method of claim 12, further comprising, prior to the providing step, mixing a  
2       first solution containing the carrier protein and the drug with a second solution containing the  
3       mucopolysaccharide to produce the precipitating solution.

1       24. The method of claim 12, wherein the precipitating solution contains zinc or  
2       calcium ions.

1       25. The method of claim 12, further comprising  
2       suspending the insoluble product in a preparatory solution having a pH of about 6 to 8  
3       to form a mixture; and  
4       lyophilizing the mixture to obtain a solid product.

1       26. A composition providing sustained release of a drug, the composition comprising  
2       a mucopolysaccharide and a protein drug.

1        27. The composition of claim 26, wherein the composition consists of the  
2        mucopolysaccharide, the protein drug, and one or more pharmaceutically acceptable  
3        additives.

1        28. The composition of claim 26, wherein the mucopolysaccharide is chondroitin  
2        sulfate or hyaluronate.

1        29. The composition of claim 26, wherein the protein drug is an erythropoietin,  
2        granulocyte colony stimulating factor, granulocyte-macrophage colony stimulating factor,  
3        thrombopoietin, interferon- $\alpha$ , interferon- $\beta$ , interferon- $\gamma$ , urokinase, tissue plasminogen  
4        activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,  
5        brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide  
6        dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1        30. The composition of claim 26, wherein the composition contains about 0.1 to 50%  
2        by weight the mucopolysaccharide.

1        31. The composition of claim 26, wherein the composition contains about 0.1 to 50%  
2        by weight the protein drug.

1        32. A method of producing a sustained release drug composition, the method  
2        comprising

3              providing a precipitating solution containing a mucopolysaccharide and a protein  
4        drug;

5              lowering the pH of the precipitating solution to a level sufficient to form an insoluble  
6        product comprising the mucopolysaccharide and the protein drug; and

7              collecting from the precipitating solution the insoluble product.

1        33. The method of claim 32, wherein the insoluble product consists of the  
2        mucopolysaccharide, the protein drug, and one or more pharmaceutically acceptable  
3        additives.

1       34. The method of claim 32, wherein the mucopolysaccharide is chondroitin sulfate  
2 or hyaluronate.

1       35. The method of claim 32, wherein the protein drug is an erythropoietin,  
2 granulocyte colony stimulating factor, granulocyte-macrophage colony stimulating factor,  
3 thrombopoietin, interferon- $\alpha$ , interferon- $\beta$ , interferon- $\gamma$ , urokinase, tissue plasminogen  
4 activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,  
5 brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide  
6 dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1       36. The method of claim 32, wherein the pH of the solution is about 7 or above  
2 before the lowering step.

1       37. The method of claim 32, wherein the pH of the solution is lowered to about 2 to 4  
2 in the lowering step.

1       38. The method of claim 32, further comprising, prior to the providing step, mixing a  
2 first solution containing the protein drug with a second solution containing the  
3 mucopolysaccharide to produce the precipitating solution.

1       39. The method of claim 32, wherein the precipitating solution contains zinc or  
2 calcium ions.

1       40. The method of claim 32, wherein the insoluble product contains about 0.1 to 50%  
2 by weight the mucopolysaccharide.

1       41. The method of claim 32, wherein the insoluble product contains about 0.1 to 50%  
2 by weight the protein drug.

1       42. The method of claim 32, further comprising

2 suspending the insoluble product in a preparatory solution having a pH of about 6 to 8  
3 to form a mixture; and  
4 lyophilizing the mixture to obtain a solid product.

1 43. A method of delivering a drug to a subject, the method comprising introducing  
2 the composition of claim 1 into the subject.

1 44. The method of claim 43, wherein the composition is introduced subcutaneously  
2 or intramuscularly into the subject.

1 45. A method of delivering a drug to a subject, the method comprising introducing  
2 the composition of claim 26 into the subject.

1 46. The method of claim 45, wherein the composition is introduced subcutaneously  
2 or intramuscularly into the subject.